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New Advertisements.

In the growth of THE ELECTRICAL WORLD in circulation, size and general improvement, the value of its columns for reaching those engaged in electrical pursuits or interested in electrical matters has not failed to be appreciated by advertisers. Readers will find it to their advantage to keep their eyes on the advertising as well as the reading columns. The following are the new advertisements in this issue:

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VOL. XI. NEW YORK, JAN. 14, 1888. No. 2.

A Few Improvements. IT will be noticed that in the present issue of THE ELECTRICAL WORLD a few improvements have been introduced, the object of which is to render more easy and expeditious reference to its contents. We are often asked to inform our readers where certain editorials or items of news in the special correspondence can be found, and in order to save the time of the many who have occasion to refer to back numbers we have adopted a system of giving titles not only to the matter on this page, but to that which appears in the department of correspondence. There is now no matter in the paper which is not thus titled and classified, either under its departmental headings or in the regular weekly "Contents." We believe our readers will appreciate this effort to render our columns more valuable as a record of what is being done.

Storage Battery Cars. IN commenting upon the controversy which has been going on in our columns for the past few weeks in regard to the performance of two storage battery cars, a third correspondent now calls the contestants to account by demanding figures as well as bets. This request is quite a reasonable one, and though it appears unlikely that the challenge held out by one of the parties will be accepted, we will gladly lend our space to a discussion of the relative performance of each car, based upon actual figures and tests.

The National Electric Light Association. STEPS are already being taken, as our recent issues have shown, to prepare for the next meeting of the National Electric Light Association, which is to be held at Pittsburgh next month. While it cannot be said that the six months that have passed since the Boston meeting have seen any very great changes in the electric light industry, there is little doubt that the convention will have a variety of important business before it, and many weighty questions to settle. The fact that the meeting is held at Pittsburgh is of itself sufficient to insure a large attendance.

The Employment of Electric Motors. EVERY day some new employment is being found for electric motors and in the industries where they have already been put to work their use is greatly on the increase. In this issue, we illustrate two very distinct lines of work for motors, one being that of pumping and the other that of furnishing power for a printing establishment. In the latter case it will be seen, the motor replaced a steam engine, and has been found more satisfactory. Not only has it done all that was expected, but its use has permitted an increase in the printing plant. One cannot well conceive a motor better adapted to printing office work than the electric.

Safety Fuses. THOUGH accidents due to the inoperativeness of safety fuses are now comparatively rare, it is always well to note an improvement which may make those at present in use still safer. Thus it is suggested in another column that the point at which the fuse is calculated to act can be very closely maintained by weighting the fuse. This not only overcomes the bad effects of an oxidizing film on the fusible metal, but it causes the rupture of the fuse before the absolute point of danger is reached. It will suggest itself to our readers that the conduction of heat from the fuse to the weight can be obviated by a non-conducting connection instead of a metallic one.

Lighting Sleighs by Electricity. WE are always glad to see any extension of the work of electricity, but we have our doubts as to the popularity of the last application reported from New England. It is none other than the lighting of sleighs by little storage plants which feed lamps of six candle power, placed on the vehicle. We were under the impression that as a good, old-fashioned convenience for undisturbed courting, the sleigh has had no rival, but it will lose its high position if this new custom be generally introduced, and those sleighs will be most called for where the "sparking" can be done without the help of sparks, electric or otherwise. Still a remedy may be found in the plan adopted in that famous dispute between the eyes and nose, as to wearing glasses, which was that when Nose put spectacles on, Eyes should be shut.

A Review of the Work of 1887. WE print on another page the review of the scientific work of 1887 as presented by Mr. J. Wetzler recently before the New York Electrical Society. The review will be found complete and very convenient for purposes of reference and comparison. It brings out several points in a striking manner. Thus it will be observed that the year is practically bare of results in static electricity, while, on the other hand, investigation in the new, old field of thermo-electricity has been carried on with amazing energy and variety of direction. It is not safe to predict the course that electrical work is likely to take at any time, but it seems within prudence to say that 1888 is likely to witness a continuance of study in the field of thermo-electricity, even to the neglect of other lines of investigation that heretofore have been highly favored by scientists and inventors.

Electricity from Carbon. THE paper of Mr. W. E. Case, read before the American Institute of Electrical Engineers, and printed in another column, shows clearly that the true value of any process for converting heat energy into electricity must depend upon the range of temperature to which the apparatus or materials employed can be brought. Since this law of thermo-dynamics is inexorable, and arguing from the standpoint that even under the best conditions a conversion of heat into any other form of energy entails considerable loss, Mr. Case thinks the solution of the problem ought to be sought in a method of conversion not involving heat. The galvanic battery seems to be the only method practically available at present, and hence Mr. Case has constructed a carbon-consuming battery, the details of which he describes. Granted even that it be true that the conversion of heat into electric energy is accompanied by a large loss, this method is one by no means to be neglected, as the question of its efficiency compared with other methods is merely one of relative proportion. That is to say, if heat can be converted directly into electricity with a loss of even 80 per cent., the efficiency of such an apparatus will be more than 100 per cent. greater than that of the method now in use, in which the steam engine is employed as a medium.

The Bessbrook-Newry Electric Tramway. THE test made by so well known an authority as Dr. E. Hopkinson of the efficiency of the Bessbrook-Newry electric railroad is ample proof of the fact that this type of railway construction can be depended on for comparatively high efficiency. With the conducting rail unprotected, and raised but a few inches from the ground on plain insulators, it speaks well also for the cheapness with which such a road can be equipped. Looking at the cause of the electrical losses, which are distributed under four heads, that which will probably attract most attention is the exceedingly small loss of 7.7 per cent. in the motor. But what is especially significant in some respects is the fact that these "motors" are stated to be Edison-Hopkinson dynamos, so that these machines, under the conditions in which they are employed, are more efficient even as motors than as dynamos. If this is the case, it is evidently due to the fact that the quantity of iron in them has not been diminished to bring down their weight as motors; and this practice, we have reason to believe, will soon be followed by others, even though it be done at some loss of power, due to increased dead load. Certain it is that for an equable degree of efficiency over a considerable range of speeds a motor must have practically the same amount of iron in it as a dynamo designed to be practically equally efficient at all loads. This is especially to be kept in mind, as a street car is constantly varying in speed and over great ranges.

Electrolysis of Alloys. THE British Association, to whom the world is indebted for the establishment of the system of electrical units which now find such a wide application, has for a long time been at work, through its committee, gathering materials regarding the theory and phenomena of electrolysis. In the reports thus far published much space is devoted to the theory involving the migration of the ions, and in order to test fully the correctness and the range of the hypotheses already made, experiments were undertaken to determine the question whether alloys were capable of being electrolyzed; or, in other words, whether, in the molten state, they conduct metallically or in virtue of electrolytic action. The recent report of Roberts-Austen, trade in England, and which is confirmed by others, seems to prove quite conclusively that alloys cannot be electrolyzed in the true sense of the word. Indeed, if such had not proved the case, the theory of electrolysis previously advanced, and which is tolerably satisfactory, would have fallen to the ground. For the latter theory is based upon an interchange of the atoms in a solution electrolyzed; that is, it presumes the chemical atomic union of the constituents of the substance acted upon. But alloys have always been regarded as nothing more than mixtures of metals or the solution of one into the other; that is, as molecular combinations, in contradistinction to the atomic. It goes without saying, therefore, that if a single element cannot be electrolyzed, a *mixture* of two or more, provided no chemical combination takes place between them, can also not be electrolyzed.

Government Telegraphs. THE objections to government telegraphs have been summed up recently in a very pithy manner by United States Senator Hoar. In the course of a letter elicited by the petitions in favor of state-owned telegraphs, circulated by the Knights of Labor, Mr. Hoar says: "I think the existing monopoly of the means of telegraphic communication in this country is one that should not continue. I think Congress has ample power to regulate the prices and conditions of telegraphic communications among the States and with foreign countries, as it already has exerted the power to regulate transportation among the States over railroads. I think that it unquestionably possesses the further power to construct national lines of telegraph at the public expense and operate them, as it now establishes post offices and post roads, and takes charge of the postal service. There are, however, two serious difficulties which need to be overcome. First, there is danger that in times of great political excitement or strife the government may abuse its power over private correspondence of the people if it has charge of the telegraph. Letters sent by mail are sealed, and very severe penalties are enacted for the offence of opening them by the public officials or other persons before they reach their destination; but two public officers, at least, one at the station and the other where it is delivered, must know the contents of every telegraphic transmitted message. This in a time of civil strife, or great and bitter political controversy, is a most dangerous power to be possessed by any government, and one to which the free spirit of the American people will never submit. The second difficulty is the necessary increase of political patronage with which the executive is clothed already to far too great a degree." As Mr. Hoar points out, there would be the addition, at one time, of over 50,000 people to the number of federal office holders, and like ourselves he is not eager to see so vast an increase of power as this signifies bestowed on the central government. If the telegraph can be brought under supervision, much that is now sought for will be gained.

NEW BOOKS.

KALENDER FUER ELEKTROTECHNIKER. Fifth year, 1888. By F. Uppenborn. Munich and Leipzig: R. Oldenbourg. 1888.

This pocketbook for electricians is so well known that we need not dwell upon it at length. We may remark, however, that the present edition is considerably increased in size, so that a supplement has been made necessary. The book is bound in very convenient form and contains the latest information available.

L'ELECTRICITE; NOTIONS ET APPLICATIONS USUELLES. By Aug. Michaut. Paris: 1888. George Carré. 412 pp., 5 × 8 inches.

The object of this volume, which constitutes No. 1 of the "International Library of Electricity and its Applications," is to give the student in the first place a clear idea of electricity, which is indispensable to an understanding of its numerous applications at this time. The book passes in review all the principles of electricity and explains them, unencumbered by formula. It also follows out theories into the various applications.

The book is well brought up to date and the whole subject is handled in a clear manner, the text being elucidated by no fewer than 300 engravings.

NINTH ANNUAL MEETING OF THE NATIONAL TELEPHONE EXCHANGE ASSOCIATION. Published by the Association. New York. Pp., 120.

The contents of this volume have already been made public, being the proceedings of the convention held at Pittsburgh last September and reported in the journals at that time. It will be remembered that a number of valuable papers were then presented. All of them appear here, with the discussion on each in full. The compilation and editing has been done with care and skill by the Secretary, Gen. C. H. Barney, and the whole is a creditable record of the intelligence brought to bear on the practical work of telephony by those who are most prominent and active in that field. If we may particularize, we would point to the papers of Mr. E. J. Hall, Jr., on long distance work, Mr. T. D. Lockwood on the development of telephony, and Mr. A. V. Garratt on wire gauge, as being the most valuable contributions, although the papers and discussions on underground work are by no means to be passed over.

An Electrical Type-Writer.

This apparatus, which is described by F. Higgins in the *Electrician*, and which fulfills the functions of a type-writer at any distance from the keyboard, consists of a type wheel, which contains the letters of the alphabet, numerals, and stops. The rotation of the type wheel is effected by means of intermittent currents transmitted from a commutator under the control of a piano-forte keyboard acting on propelment pallets carried by the lever suspended over an electro-magnet. The number of currents transmitted determines the position of the type wheel with respect to the swinging frame, which serves as a guide to the paper and at the same time as a platen to make the impression. This frame is pivoted at its end, and carries an armature which is acted upon by an electro-magnet.

The type wheel is automatically traversed horizontally after the printing of each letter, in order to take up a position for the succeeding character until the end of the line is reached, when the operator restores the type wheel to the starting position by pressing the appropriate key. At the time this takes place the paper is advanced sufficiently to space between the lines, and the operator may, by making successive contacts, rapidly advance the paper as much as may be required either to commence a fresh subject or to eject sufficient paper to bring the end of the message well into view.

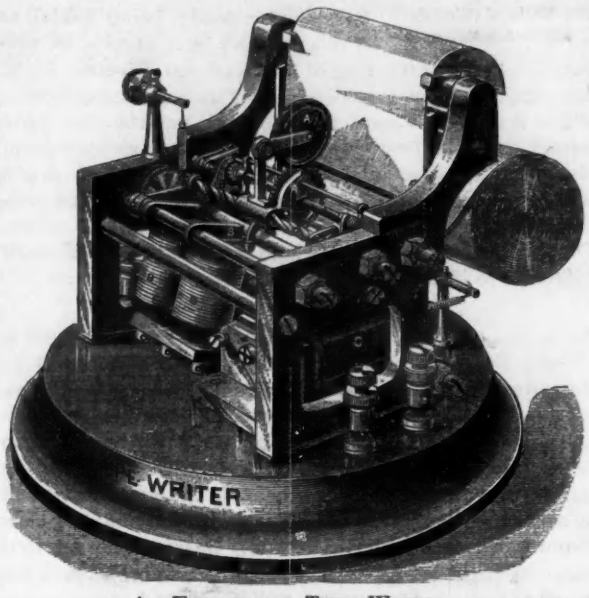
The lateral spacing of the characters is uniform and is determined by the printing operation. The platen frame in falling back rotates a screw which carries the type wheel and ink roller. The spacing between the lines and the return of the type wheel to the starting point are effected at the same time by pressing a key which corresponds to a position on the commutator and the type wheel which is not occupied by a letter. A pin projecting from the type axis at this point causes the intervention of a block which acts as a fulcrum to a lever connected to and worked by the platen, but which only comes into operation to release the type wheel when thus provided with a fulcrum, and consequently only when the act of printing takes place with the type wheel in this position. A spring returns the type wheel to zero.

Synchronism between the receiving and transmitting apparatus is secured by means of a lever, which is geared to a type axis by friction, and is carried by the revolution of the latter into the path of a projecting pin. Upon a print being made this lever is reset at its starting point, but should three revolutions of the type wheel be made without a print the wheel will be arrested at zero. By commencing a message always upon the zero or spacing key of the transmitter, the apparatus will be in unison.

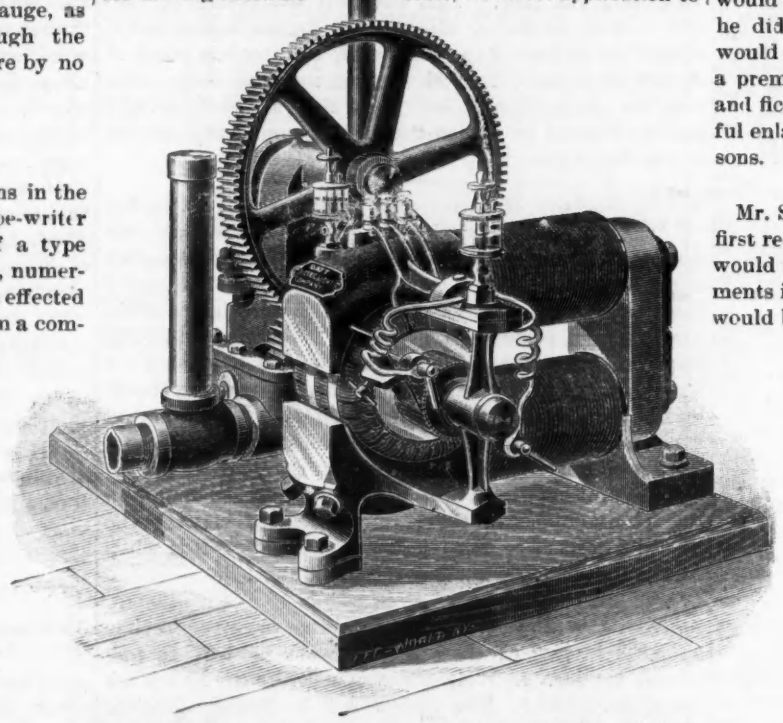
Ink is supplied from an inking wheel in the usual manner. In the illustration, *A A* represent the type-wheel, axle and ink roller, *C* the printing magnet, *B B* the type propelling pallet and armature magnet, and *D* the screw for returning the type to zero.

Combination of Daft Motor and Worthington Bucket-and-Plunger Pump.

The vast field that is awaiting occupancy by distributory systems of electric power has begun to reveal its extent at a literally startling rate. No longer confined to the limits of electric manufactories—and even there regarded as hardly more than a laboratory "fluke" or a mere convenience—it has stepped into modern industrial and social life with an assurance that declares as roundly as words: "J'y suis, j'y reste." It is almost useless to refer to its employment for driving machine tools, its direct application to elevators and lifts, as well as to ventilators and blast wheels, but of its domestic uses very little has so far been said.



AN ELECTRICAL TYPE WRITER.



COMBINATION OF DAFT MOTOR WITH PUMP.

The accompanying illustration is a happy combination of a Daft motor with a Worthington bucket-and-plunger pump, for use in conjunction with a hydraulic elevator. The pump, at a speed of two hundred revolutions per minute, will deliver about five hundred gallons of water per hour against a head of one hundred feet, and requires, at this rate, inclusive of frictional resistances, one and a half horse-power of the motor. The latter easily develops two horse-power, day in and day out, which affords an ample margin for any possible emergency.

A simple automatic device stops the motor when the tank into which it is pumping is sufficiently full and starts it again when the water-level falls to a definite point. This appliance is literally and infallibly automatic. The combined apparatus will stand in a floor space of four square feet, and its extreme height is less than two feet.

Compact as this is, it is but fair to say that a much higher degree of this quality could be obtained by a mutual modification and adaptation of the machines. In the present case standard types of each were coupled together without the slightest alteration in either. The object of the union, as before stated, was to exhibit something available for use with hydraulic elevators, but it is equally suited for any domestic service.

It should be better known than it is that, wherever an electric circuit is within reach, private families may not only enjoy the luxury of elevators within their homes without the hitherto inseparable cost and annoyance of attendance, fire-risk, heat and dust, but may also have power, figuratively, "on tap," with as little trouble or danger as water or gas, for the thousand and one domestic necessities that now waste the time, strength and temper of servants in labor of unintelligent "vain repetition." A butler's pantry with electric power for polishing knives and revolving a stone and a buff-wheel for sharpening them; or a laundry drying-room with its atmosphere rapidly and regularly changed by a blast-wheel or ventilating fan, will incalculably enhance the comfort and content of a household from highest to lowest, and produce a moral effect that extends further than one would dream.

A city ramified with an effective system of underground conduction and amply equipped with distributory electric power installations seems Utopian at present writing; but, after all, it is in the very near future, and multitudes alive to-day will see it. Even to-day the idea is being realized in its earlier stages and in measurable degree.

A Few Comments on Patent Law Revision.

BY R. M. HUNTER, M. E.

With reference to the paper read by Mr. Arthur Steuart on the revision of the patent law, read before the American Institute of Electrical Engineers, under the headings of "Reissues," "Licenses," "Joint Owners" and "Assignments," I would beg leave to say a few words. I cannot agree with him in many points under these heads for the following reasons:

Reissues.

Mr. Steuart wishes to allow the owner (not the inventor) to apply for a reissue to enlarge the scope of the patent without the oath, signature or consent of the inventor. This is out of the question, for many an inventor in describing his own invention describes the inventions of others, to which he lays no specific claim. Under Mr. Steuart's proposition, the capitalist who buys the patent might wish to broadly claim that which the inventor would not, and could not conscientiously claim, or hold if he did claim it by perjuring himself. Such a change would remove the restraining effect of the oath, and put a premium upon dishonest presentation of applications and fictitious sales for the purpose of enabling this wrongful enlargement by reissues obtained by irresponsible persons.

Licenses and Assignments.

Mr. Steuart would make the title clear in the party who first recorded his license or assignment. This certainly would not be fair, for the only place to record such documents is in the Patent Office, and under such ruling there would be no safety, except the papers were executed in Washington and immediately put on record. A party might give a power of attorney to sell his patent in New York and then go to San Francisco and make a bona fide sale for a large amount. After which he telegraphs his attorney in New York to sell quickly to a friend for a small amount and record the assignment, the record taking place some two weeks before the assignment from California could possibly reach Washington. The inventor then comes East, gets rid of the money (so far as the law is concerned) and the patent is still in his possession by his friend, an innocent purchaser (?) from the agent. With ordinary mortgages it is different, as the record is made close to where the sale is made and the opportunities for such frauds are far less.

Joint Owners.

The present law is correct. No other law would be equitable. Mr. Steuart's idea of applying the same rule as that of joint or co-owner of a building to patents would not work. Once a building is erected any one can take care of it, and it usually pays without the requirement of particular brains on the part of either co-owners. In the case of a patent this is not so. The inventing is the easiest part of the undertaking. The perfecting and introduction of the invention requires not only skill but large outlays in money. It would be absurd to say that an idle thriftless inventor should have a right to claim one-half of all the profits made by the labors and money of the industrious and skillful mechanician. At present if the parties are desirous they can enter into a mutual contract, and they must be the judges as to the policy of binding themselves to each other.

Breaking Incandescent Lamp in Explosive Gases.

To the Editor of The Electrical World:

SIR: As I am experimenting in this line, I would be pleased if THE ELECTRICAL WORLD, or any of its readers, could give me any information they have in regard to experiments that have been made to show the effect produced by breaking incandescent lamp bulbs in explosive gases.

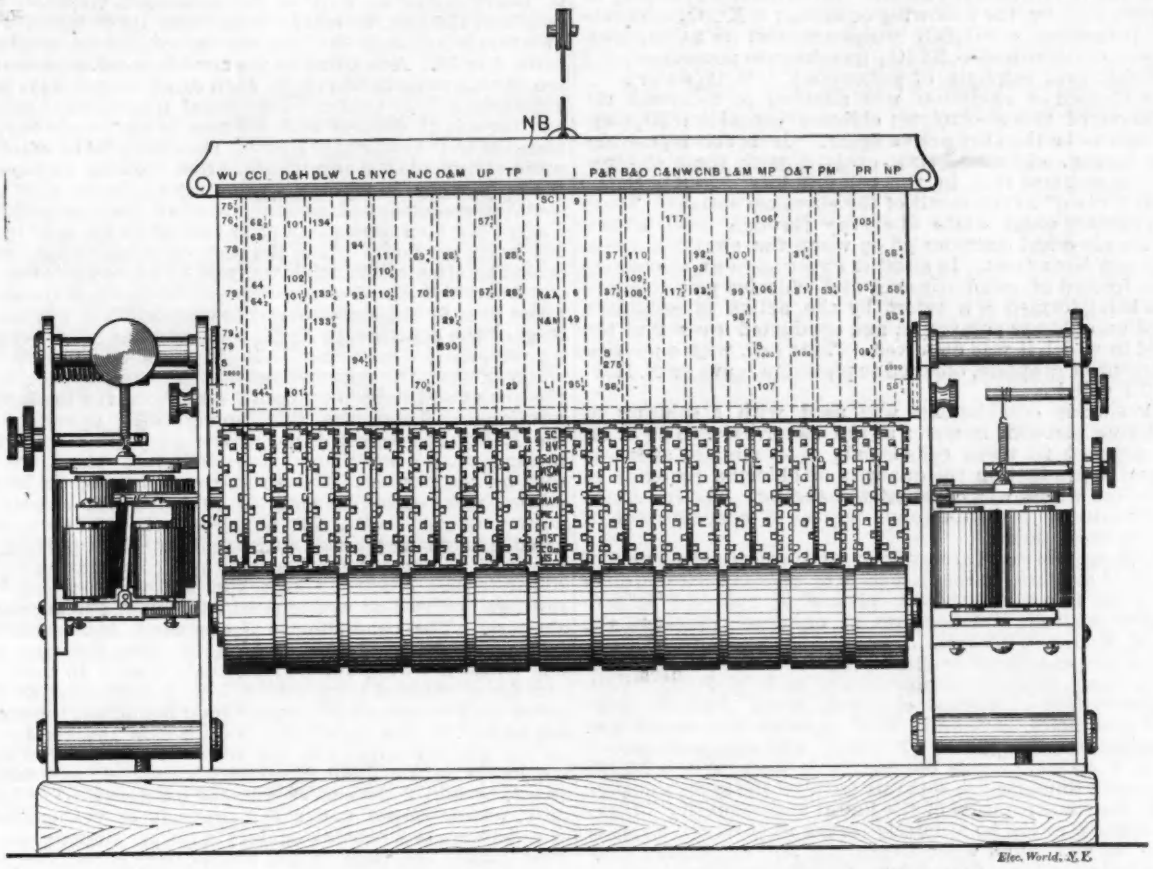
H. HUTCHINS,
Lieut. U. S. N.

NEWPORT, R. I.

Burrton, Kan., has a central station storage battery plant, with Electrical Accumulator Company's cells.

The Wiley Stock Printer.

In our last issue we described a form of stock quotation instrument in which it is sought to overcome some of the inconveniences attached to the present mode of recording. Thus, instead of giving the quotations in two lines on one long, narrow strip, which has to be gone over to a great length in order to get at the quotations of any individual stock, the Wiley instrument prints each quotation in a separate column on a board, as shown in the accompanying



THE WILEY STOCK QUOTATION PRINTER.

illustration. With this end in view each stock is marked on a sign board placed at the top of the wide roll of paper and to each stock a separate printing wheel is assigned. By suitable arrangement it is so contrived that only one wheel prints at a time, according to the quotation of the stock to be recorded. In the centre of the board there are two columns marked *I I;* in one of these the names of inactive stocks are printed when it is desired to quote them, and in the adjoining column the price. Thus a means is provided for allowing the quotation of a large number of stocks, even though several be inactive and seldom quoted. Fuller details will be found in our article of last week, but we have thought the improvement of sufficient value and importance to be illustrated with a more explicit engraving then was than used.

Safety Fuses for Electric Light Circuits.

At a recent meeting of the English Society of Telegraph Engineers and Electricians, Mr. A. C. Cockburn, of the Finsbury Technical College, read a paper entitled, "On Safety Fuses for Electric Light Circuits, and on the Fusing Points of Various Metals usually Employed in their Construction." The author mentioned that inefficient fuses, often used for the sake of cheapness, are in themselves a source of danger, and gave instances of fires the origin of which had been traced to defective fuses. He insisted on the importance of using double pole fuses, viz., placing a fuse upon each of the leads. According to the author, the following are the principal conditions which should be fulfilled by a good fuse: It should act with certainty within from 5 to 10 per cent. of the current strength at which it is intended to fuse. It should not alter much with time. The contacts should be such as to allow, without dangerous heating, the passage of at least three times the maximum current which they are intended to carry. The material should not be readily oxidizable; the wire or foil should not touch the case. The case or fuse holder should only admit the fuse specially intended for it, and should be such as can easily be fitted up by an ordinary workman. The leads should not cross. The fuse should be easily replaceable when broken. The holder should be of non-inflammable material. It should be so inexpensive that reasons of economy may not prevent its use even for single lamps; and finally, the fuse should, whenever possible, be in sight, and covered only by a transparent substance, such as glass or mica. Moving parts are in general to be avoided, owing to their liability to stick; but there is no objection to the use of electro-magnetic cut-outs on main circuits, provided they are well constructed, and proper attention is given to keep them in working order.

According to the author's experience, foil cannot be depended upon within sufficiently narrow limits of current strength, and it has the additional disadvantage of requiring to be supported throughout its length. Prof. S. P. Thompson's fuse, in which the leads are joined by means of a button of fusible alloy, was described, and also one devised by Sir W. Thomson, in which the fuse leads consist of springs, joined by a button of fusible alloy, and which fly apart when the alloy melts. If plain wire could be depended on, it would be preferable, as the fuses could be made more cheaply. For this purpose iron is objectionable, because it oxidizes readily if exposed to damp, and owing to its high fusing point it would be dangerous if used in a wooden holder which had not been made thoroughly fireproof. Copper and platinum are both open to the same objection of too high a fusing point, and copper is also found to change its fusing point after repeated heating. Lead is difficult to draw, and is very liable to damage on account of its softness, and in common with copper and iron, it oxidizes very readily when heated by the current.

The metal which the author finds best is tin containing about 5 per cent. of phosphorus. It does not oxidize very readily when heated, and not at all from moisture, and it melts at 235 degrees C., a temperature at which wood is not charred. Slow oxidation does take place when it is heated, and this has hiterto been the principal difficulty in the way of using simple wire fuses, as the film of oxide formed on the outer surface of the wire may retain the molten metal within it and prevent the circuit from being broken; and though it has been attempted to remedy this by placing the wire in a vertical position, the attempt has only been partially successful. The author has got over the difficulty in a very simple manner by placing a small leaden weight on the wire, which breaks the film of oxide as soon as the metal assumes the pasty condition through which it passes before becoming molten, and he finds that in this manner a definite fusing point, well within 10 per cent. of the current strength for which the fuse is intended to act, can be attained. An experiment was shown in which the same current was sent through two perfectly similar wires, except that one was weighted and the other not. As the current was very gradually increased, the unweighted wire attained a dull red heat, at which point the weighted wire broke without having reached redness. This experiment is very curious, as it shows that the effect of the weight is not merely to break the wire, but that with the same current the weighted wire does not attain so high a temperature as the unweighted one. It is true that the leaden weight, owing to its heat conductivity, would abstract a small quantity of heat from the centre of the wire, and owing to its electrical conductivity would slightly diminish the resistance of the small central portion of the wire in contact with it, and therefore slightly diminish the development of heat in that part; but though these minute actions might possibly produce an appreciable effect in the part of the wire immediately adjacent to the weight, it is difficult to imagine that they could do so in the more remote portions. The fuses are made in standard lengths, and are all tested up to near their fusing point before being sent out, to insure their not fusing for too low a current strength.

The Diseases of Dynamos.

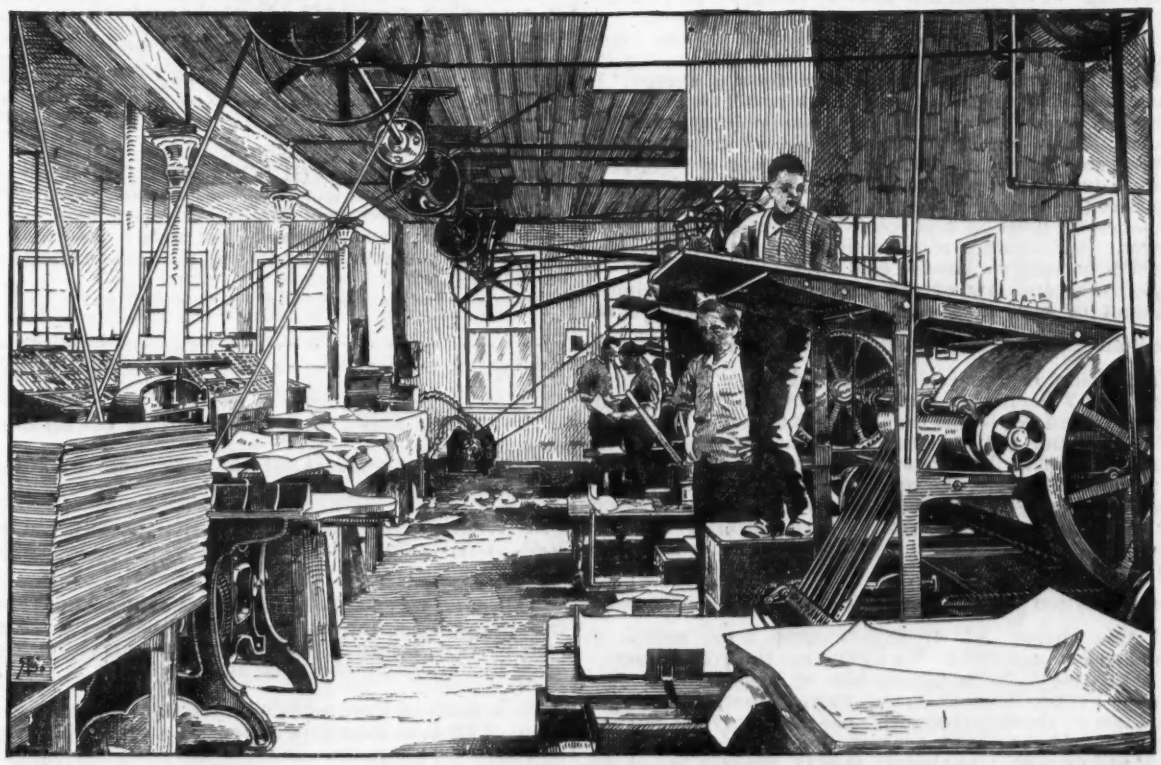
BY W. H.

I have read with much interest in THE ELECTRICAL WORLD of Dec. 17 the article on "The Diseases of Dynamos," by Sylvanus P. Thompson, in which is mentioned a small dynamo that gave trouble at the brush rocker. At one time the writer had some trouble with the insulation under the brush clamp and rocker of a Brush dynamo which caused short-circuiting. Although no serious trouble came of it, it was, nevertheless, very annoying. I believe the insulation was of fibre. For a remedy, we tried several kinds of insulation, such as mica and asbestos, but they did not last. I think the trouble was largely due to copper dust from the commutator falling on the insulation and thus making cross connection. Finally, some two years ago, we tried an insulation of slate a little larger than the brush clamp, and since then have had no trouble. I think the good results are due from the slate being waterproof and smooth on its edges.

I have mentioned this, as it may be of interest to some of the readers of THE ELECTRICAL WORLD, who have had similar trouble with insulation in wet or dusty places.

The Electric Motor in Printing Establishments.

Quite a number of enterprising newspapers already run their presses from electric motors, and private printing



A NEW YORK PRINTING OFFICE OPERATED BY SPRAGUE MOTOR.

establishments all over the country are now also awakening to the advantages attached to their use. Thus, in this city, for instance, a large number of electric motors have been put in use for such purposes, and our illustration represents a Sprague motor driving the presses in the printing establishment of Messrs. Vanden Houten & Co. The motor, of a rated capacity of 7½ h. p., drives four large cylinder presses and three Gordon job presses. Besides this the motor furnishes the power for driving an elevator which lifts a ton weight. All this load is carried with the greatest ease, and since the installation of the motor several months ago no interruption of the work of the machine has occurred. It may be remarked here that the electric

motor in this instance replaced a 10 h. p. steam engine which obtained steam from the street mains, but the steam and engine service gave so little satisfaction that the change to electricity was at last decided upon, with the results above mentioned.

Electric Energy from Carbon without Heat.*

BY WILLARD E. CASE.

The following experiments, undertaken by the author, may be of interest as indicating the way in which the cheap generation of electrical energy may possibly be brought about.

In the first experiment, an element was formed through which heat energy was converted into electrical energy, in which the correlation of forces is beautifully illustrated.

It is a sort of voltaic battery, in which plates of tin and platinum forming the electrodes are immersed in a solution of chromic chloride, which has no action on the plates at ordinary temperature, so no current is generated. The cell is hermetically sealed, and when heated the liquid becomes active, and part of one of its elements, chlorine, leaves the chromic chloride, goes over and temporarily combines with the tin, forming a proto-chloride of tin. The chemical action generates an electric current, but soon the tin is all converted into chloride, and the current ceases. When the cell is cooled, this temporary combination of the chlorine and tin is broken up, and the chlorine returns to the chromium proto-chloride. The tin being set at liberty, falls as a metallic precipitate to the bottom of the cell in the form of crystals, ready to renew the combination when the cell is again heated. None of the materials of the element are destroyed, they last an indefinite time. The chlorine changes from chromic chloride to tin and back, as often as the cell is heated and cooled.†

It is well known that the voltaic battery converts the potential energy of a metal directly into electricity, without heat. This cell, similar to the voltaic battery, converts heat into electricity. The voltaic battery acts at ordinary temperatures, giving up all the energy stored in the metal, and there is the end of it; while this cell acts only when heat is applied to it, converting part of this heat into electricity. After the tin has all been converted into chloride the cell becomes inert, no matter how much more heat be applied. The cell must then be cooled to get this tin back into the metallic state, so here it is necessary to have a difference of temperatures, the tin and liquid being simply a medium by which heat is transformed into electric energy.

It will probably be found that the solution of the tin absorbs heat, and so tends to cool the liquid, and the precipitation develops heat, and so tends to warm the liquid, and that the part where the solution occurs must be kept warmer than that where the tin precipitates. An investigation would probably show that when electric currents are generated the heat absorbed by the solution of the tin is in excess of that generated by the precipitation by the equivalent of the electrical energy developed, and that the possible excess is governed by the second law of thermo-dynamics. If the cell works between 80° and 180° F., the E. M. F. at the higher temperature is about 0.26 volt, the efficiency is less than 16 per cent., as the possible efficiency $= \frac{T - t}{T}$ reckoned from absolute zero, or $\frac{638° - 538°}{638°} = .157$.

In fact, this cell is a heat engine, analogous to the thermopile, which is said to convert only 2 per cent. of the energy of the coal into electric energy. In practice, probably nothing like 16 per cent. could be utilized.

It is an inexorable law of nature, that under the conditions in which we live a great waste must accompany the transformation of heat into any other form of energy. In the condensing steam engine it requires to condense the steam four or five pounds of water to every pound of steam. Three-fourths the heat used goes to warm that water, and is wasted. In hot air engines or gas engines a cold water jacket must be used, and to it goes the larger share of the heat employed. In the thermopile one set of junctions must be kept cool by circulation of air or water. In Edison's pyromagnetic generator the iron tubes must be cooled by a blast of cold air.

By the second law of thermo-dynamics the minimum amount of heat that goes to this cooling agent is the fraction $\frac{t}{T}$ of the total amount employed, where t is the temperature of the cooler reckoned from the absolute zero and T the higher temperature of the working substance; t can not be less than about 500°, so the numerator of the fraction is always large, and the heat wasted is the larger portion. Understand that this is a law of nature; it is inevitable under the conditions in which we live. No cunningly devised furnace, or feed water heater, or cut-off, or triple expansion apparatus, or pyro-generator can save this heat. The most that any of these devices can do is to save what would otherwise be wasted over and above the proportion $\frac{t}{T}$. But are we to go on wasting all this energy of fuel? Cannot some means be employed to utilize it? We know that the voltaic battery is not a case of the transformation of heat into electrical energy; it produces electrical energy directly. The second law of thermo-dynamics does not apply, as no heat appears. If we could convert the chemical energy of coal and oxygen into electric energy, directly and cheaply, we would do away with all our steam motors at once. There is no known reason why a cheap substance may not be found which will act on coal and develop electric currents in place of heat. This electric energy would be the equivalent of the heat energy that would be developed by the combustion of the same coal in the ordinary way, and could be transformed into mechanical power, heat, light, etc., with small loss.

So far, little progress has been made in this direction. Some time ago, Jablochkoff produced a battery in which plates of carbon and iron were immersed in fused nitre. The carbon being oxidized, furnished strong currents. The objection to this element is the generation of heat through local action. To it the second law does not apply. Another experiment of more interest than the first is an illustration of an element which is not affected by the second law, as heat is not essential to its operation. The energy due to the complete oxidation of carbon is converted into electric energy directly.

In a glass cell containing sulphuric acid, C. P. Sp. Gr. 1.81, temp. 75 Fah., two electrodes were immersed, one of platinum, the other of lump graphite; only a slight E. M. F. was indicated, 0.007 volt, due to the combination, the graphite acting as a positive element; on the addition of a small quantity of chlorate potassium to the acid, the E. M. F. immediately rose to 00.8 volt, the graphite being disintegrated after a time. This cell polarized rapidly, which was partially prevented by mechanical means. The reaction of chlorate potassium with sulphuric acid may be represented by the following equation: 3 $KClO_3$ (chlorate of potassium) + 2 H_2SO_4 (sulphuricacid) = 2 ClO_2 (peroxide of chlorine) + $KClO_4$ (perchlorate potassium) + 2 $KHSO_4$ (acid sulphate of potassium) + H_2O (water).

A method of exclusion was adopted to ascertain the oxidant of this electrolyte: chlorine peroxide (ClO_2) appeared to be the only active agent. It is decomposed by the carbon, chlorine being evolved with some oxygen. It was assumed that in this cell graphitic acid ($C_1H_2O_3$) was formed* as the result of the chemical actions. There is probably much waste of energy through local action, as the chemical reactions go on when the circuit is open, but to a less extent. In another experiment an electrolyte was formed of sulphuric acid and chlorine peroxide, the gas being formed in a retort by the action of sulphuric acid on chlorate potassium, and conducted over into the acid in which it was dissolved. This cell, with a positive element of graphite, opposed to platinum, gave an E. M. F. of 0.7 volt.†

A similar combination was used with a solution of chlorine peroxide in water as the electrolyte. The E. M. F. assigned to these cells is only approximate, as it was found dependent on the quantity of chlorine peroxide in solution, which was constantly changing. The resistance also varied with the different degrees of concentration of the exciting fluid.

Different forms of amorphous carbon were substituted in place of graphite in the first form of cell. Gas carbon gave an E. M. F. 0.007 volt when opposed to platinum in sulphuric acid; on the addition of chlorate potassium the E. M. F. rose to 0.5 volt.

Carbon, produced by the action of sulphuric acid on cane sugar, in this experiment gave an E. M. F. of 0.8 volt.

The carbon of animal charcoal, wood charcoal, coke and anthracite, gave an E. M. F. variable with each form, ranging from 0.3 volt to 1.25 volt. The measurements of E. M. F. of the various combinations were made with the electrode immersed in separate parts of the same solution, that the concentration of the liquid and quantity of gas in solution might be as nearly equal in each cell as possible. It was found when the carbon in comminuted form was contained in a porous cup, that the combination gave an E. M. F. of 1.24 volt, apparently due to the presence of the oxygen of the air.

It is impossible at the present stage of the investigation to assign any definite value of the E. M. F. to these forms of amorphous carbon. In some cases they appear to have an E. M. F. higher than that of graphite.

The energy of the combination of carbon and oxygen when completely oxidized to (CO_2) carbonic acid gas is stated to be 9624. foot-pounds per grain equivalent, which is 2.0594 equivolts.‡ In these carbon elements the E.M.F. is not so high, as there must be deducted the counter E. M. F. or polarization, and the energy due to the force of setting chlorine free.

A resort to chemical analysis, of the products formed by the reaction in the cell, indicates the following conclusions:

First.—Carbon produced by the action of sulphuric acid on cane sugar proved to be partially oxidized, or impure carbon.

Analysis gave the following values:

C	62.20 per cent
H	1.61 per cent.
O	36.19 per cent.

Analysis proves that (H_2SO_4 + $KClO_3$) sulphuric acid + chlorate of potassium oxidizes carbonaceous bodies, like the above product of (H_2SO_4) sulphuric acid on cane sugar, to CO_2, and further, that such bodies first are changed to compounds soluble in the acid (caramel-like substances), which are rapidly oxidized to CO_2.

Second.—Battery carbon of the composition:

C	96.20 per cent.
H_2O	.70 per cent.
Iron, SO_2	2.30 per cent.

The fact was shown that this form of carbon can be oxidized to CO_2.

Third.—Wood charcoal, of the following composition after ignition:

C	94. per cent.
H_2O	5.5 per cent.
Silicious res.	.5 per cent.

This, after repeated re-ignition, was oxidized by the electrolyte to CO_2, no intermediate compounds being formed, and further, in case of pure amorphous carbon the oxidation is complete; that is, that all the carbon is oxidized to CO_2.

These analyses were made with the solution at a temperature of 122 F. to hasten the action, the carbon being in contact with the platinum. In these elements the oxidizing material is too expensive for practical use.

Undoubtedly the direction of experiments in the future will be to find some cheap substance which will absorb oxygen from the air and give it up to the carbon; in fact, acting as a carrier of oxygen, so oxidizing it without heat; and this is not improbable, as we already know of substances which do this, though giving a low E. M. F.; thus, for instance, the ferric salts are reduced to ferrous by agitating their solutions with carbon, being regenerated by absorbing oxygen from the air.

By pursuing this line of investigation, we can be sure we are not ignorantly striving against any law of nature when attempting to convert the whole potential energy of carbon into electrical energy.

* Read before the American Institute of Electrical Engineers, Jan. 10, 1888.

† This cell has been described in *Proc. Roy. Soc.*, No. 244, 1886.

* See *Q. Jour. Chemical Soc.*, Vol. XII., October, 1859.

† Great care must be taken in the preparation of this gas, as it explodes at a temperature of about 140 F. It can be preserved in the dark, and is decomposed by sunlight into its component parts.

‡ See Sprague's *Electricity*, p. 519.

The Bessbrook & Newry Electric Tramway.*

BY DR. E. HOPKINSON.

Although a number of electrical tramways had been constructed in the United Kingdom during the last few years, there had hitherto been no attempt at the regular haulage of minerals and goods, nor at the operation of cars larger than the ordinary tramway type. Probably in no case had the effective power of any single motor exceeded about 4 horse-power. The principal object of the present paper is to describe the construction and to discuss the working of the Bessbrook & Newry Electrical Tramway, which has been designed for the haulage of heavy goods as well as for passenger traffic. The length of the line is rather more than three miles, with an average gradient of 1 in 86, the maximum gradient being 1 in 50. According to the conditions of the contract ten trains were to be run in each direction per day, providing for a daily traffic of 100 tons of minerals and goods, and capable of dealing with 200 tons in any single day, in addition to the passenger traffic. The electrical locomotive was to be capable of drawing a gross load of 18 tons on the up-journey, in addition to the tear of the car itself and its full complement of passengers, at an average speed of 6 miles per hour, and a load of 12 tons at an average speed of 9 miles per hour. Also, the cost of working, as ascertained by six months' trial, was not to exceed the cost of steam-traction on a similar line. The line was formally taken over by the company, as having fulfilled the conditions of the contract, in April, 1886, and has since been in regular daily operation. It is worked entirely by water-power, the generating station being adjacent to the line at a distance of about 1 mile from the Bessbrook terminus. There are two generating dynamos of the Edison-Hopkinson type, driven by belting from the turbine shaft, which is extended into the dynamo shed for the purpose. The turbine can develop 62 horse-power, and each dynamo is intended for a normal output of 350 volts, 72 ampères, though they are capable of giving a much larger output. The current is conveyed to the locomotive cars by a conductor of steel, rolled in the channel form, laid midway between the rails, and carried on wooden insulators nailed to alternate sleepers. The conductor is not secured, but is simply laid upon the insulators, which fit into the channel, and while allowing for longitudinal motion to compensate for changes of temperature, hold it laterally. At one point the line crosses the county road obliquely, the crossing being 150 feet in length. In this case the conductor on the ground level was not feasible, and an overhead conductor on Dr. John Hopkinson's system was substituted, by which the collector on the car consisted of a bar only, which passed under the supports of the overhead wire and made a rubbing contact with its under surface. This system has been found to give very satisfactory results in practice.

The locomotive equipment of the line consists of two passenger cars, each provided with a motor. The body of the car is carried on two four-wheeled bogies, the motor being fixed on the front bogie, so as to be entirely independent of the body of the car. The longer of the two locomotive cars is 33 feet in length, and is divided into three compartments, the front one covering the motor, and the two others forming first and second class compartments, together accommodating 34 passengers. The front bogie carrying the motor has an extended platform, projecting beyond the body of the car, and communicating by a slide door with the dynamo compartment, thus giving the driver direct access to all parts of the driving machinery, which is at the same time entirely boxed off from the passenger compartments. The weight of the locomotive, including the dynamo, is 8½ tons.

Apart from the electrical working of the line, an important and novel feature is the plan by which the wagons used on the line can also be used on the ordinary public roads, so avoiding the necessity of trans-shipment, and enabling goods to be loaded at the wharves and drawn to the line by horse-power and again delivered where required. The plan was originally suggested by Mr. Alfred Holt, M. Inst. C. E., of Liverpool, and was embodied in the Lancashire Plateways scheme, for which a bill was lodged in the autumn of 1882 and subsequently withdrawn. The idea has been worked out in a practical form with great success by Mr. Henry Bancroft, of Newry, one of the directors of the Tramway Company. The wheels of the wagons are constructed without flanges, with tyres 2¾ inches wide, which is sufficient for use on ordinary roads. Outside the tramway rails, which weigh 41.25 pounds per yard, second rails were laid weighing 23.75 pound per yard, with the head ¼ inch below the head of the larger rails. The flangeless wheels ran upon these lower rails, the ordinary rails forming the inside guard. The front part of the wagon is supported on a fore-carriage, which can either be pinned or allowed freedom of motion as in an ordinary road vehicle. There is a single central coupling arranged to engage in a jaw on the fore-carriage, so as to guide it when not pinned. Shafts are attached to the fore-carriage when the wagon is to be used on the ordinary roads. The wagons are of sufficient strength to carry a load of 2 tons, and their weight without the shafts is 2¾ cwt. Experience has shown that the wear and tear, both on the wheels and rails, was not excessive, and that the traction did not much exceed, if at all, that of ordinary trucks with flanged wheels. No difficulty has been found with the horse traction on ordinary roads, and the taking on and off is conducted with great rapidity.

Each locomotive car is fitted with an Edison-Hopkinson dynamo, which is geared by means of helical-toothed wheels and a chain to one axle of the bogie. The special construction of driving chain rendered necessary by the severe conditions under which it had to work, was fully described. The trains are commonly composed of one locomotive car and three or four trucks; but frequently a second passenger car is coupled, or the number of trucks increased to six. Thus a gross load of 30 tons was constantly drawn at a speed of six or seven miles per hour, on a gradient of 1 in 50. The cars could be reversed by reversing the current through the motor without change of lead, but as there was a loop at each end of the line, reversal was only required when shunting in the sidings. The terminal loop curves were of 55 feet radius only, but these were traversed by the long locomotive cars with perfect ease, to which the method of carrying the motor-dynamo on the bogie largely contributed.

The author concluded the paper with a discussion of an extended series of experiments to determine the efficiency of the whole combination under various conditions, and the distribution of the losses. The results were illustrated in a graphic form by a series of curves. Under average conditions of working the total electrical efficiency was shown to be 72.7 per cent., the losses being distributed thus:

Loss in generator	8.6 per cent.
" leakage	5.7 "
" resistance of conductor	6.6 "
" motor	7.7 "

The friction of the bearings in both generator and motor, and the power lost in the driving gear, were excluded from these results.

In an appendix to the paper the cost of the electrical equipment of the line was summarized, and the cost of

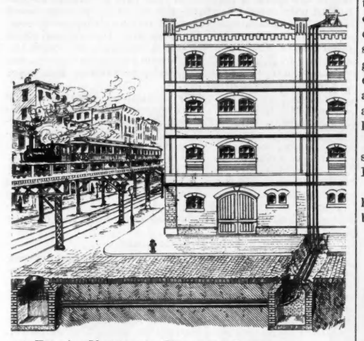


FIG. 1.—METHOD OF HOUSETOP DISTRIBUTION.

haulage per train mile was shown to have been 5.3d. over one period of five months, when the goods traffic was light, and 4.2d. when the goods traffic was heavier. Since the opening of the line the locomotive cars had registered a train mileage of 40,000 miles, and the tonnage had exceeded 25,000 tons, and the number of passengers 180,000.

* Abstract of a paper read before the Institution of Civil Engineers, Dec. 6.

The Report of the New York Board of Electrical Control.

In accordance with the requirements of the law the New York Board of Electrical Control, which succeeded the old Subway Commission, has presented its report, being the first, and covering work done since July 5, 1887. At that time about two miles of conduit were down. The

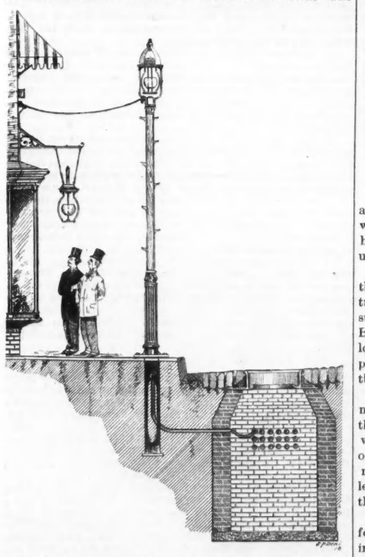


FIG. 2.—THE LAMP POST ADOPTED BY THE BOARD OF ELECTRICAL CONTROL.

present report, made by Mayor Hewitt and his fellow Commissioners, J. Hess, Theodore Moss and D. L. Gibbens, shows that the total length of trench excavated for the laying of subways since July, 1887, is 189,918 feet. The total construction of single duct for telephone and telegraph service is 903,180 feet, to which must be added 4,050 feet for distributing service and connections to central stations. Estimating 80 wires per single duct, the total capacity for telegraph and telephone service is 72,254,400 feet, or about 13,700 miles of wire. The total construction of single duct conduit for arc lighting and power service is 354,250 feet, and the capacity of this conduit may be estimated as sufficient for 2,542,500 feet, or nearly 500 miles of wire. In addition to the above the number of feet of conduit for incandescent lighting is 186,745, containing 560,235 feet of conductors.

The report gives a list of thoroughfares on which these subways have been laid, and says:

"On all the streets and avenues the companies whose wires have been provided for have been directed to remove their poles and wires from the surface within ninety days, and at the expiration of that time, in case they are not so removed, it becomes possible and proper for the local authorities to remove them forthwith.

"The capacity of conduit provided in the city of New York during the existence of the Board of Electrical Control is, therefore, considerably greater than there is in any city in the world, so far as the information of the board extends; and notwithstanding the great difficulties which surrounded this whole subject in this city, which has a greater mileage of wire than any other, and where the circumstances of underground construction are as difficult as in any other, the conversion of the present overhead to an underground system is a fact about to be accomplished, to a very great extent at least, in the near future.

"Already the Western Union Telegraph Company has some 500 miles of wire underground between Exchange Place and the Brooklyn Bridge.

"The Metropolitan Telephone and Telegraph Company has some 500 miles of wire in the Sixth avenue conduit besides hundreds of miles more in other parts of the city;

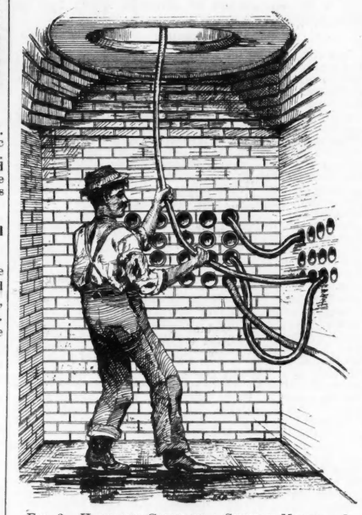


FIG. 3.—HANDLING CABLE IN A SUBWAY MANHOLE.

and the Edison Illuminating Company, whose conductors were laid in the trench at the time of construction, has, as has already been said, more than 100 miles of conductors underground.

"The Metropolitan Telephone and Telegraph Company, the Western Union Telegraph Company, the Brush Electric Light Company and others are preparing to enter the subways at many points, and should the efforts of the Board be seconded by energetic action on the part of the local authorities when the ninety days of notice have expired, many of the streets must necessarily be freed from the dangerous and unsightly pole systems."

It is added that 217 poles and 247 wires have been removed already. More would have been removed but for the fact that there is no appropriation available for this work. The report makes special allusion to the dangers of electric light wires and of underwriters' insulation, and mentions that in one instance the Board has resorted to legal measures to enforce its rulings, the case being that of the United States Electric Illuminating Company.

The subways laid, with the exception of the construction for the Edison incandescent plant, are all on the drawing-in-and-out pattern, which means, a tube or series of tubes or ducts through which cables or insulated wires can be drawn, terminating at distances of about 200 feet in boxes or manholes to which access can be had from the street by removing an iron cover. The illustrations we give on this page are fac-similes of the sketches which accompany the report, and show the methods of construction and distribution adopted. Fig. 4 shows the method of constructing the subway; Fig. 3 is a view of a manhole with a cable being drawn in; Fig. 1 shows the method of making a house top connection, and Fig. 2 is the new lamp-post adopted by the commissioners. It is of wood and has an iron base. Fig. 5 is a view of the subway for the Edison incandescent system.

It may be added that the report is supplemented by the rules governing subway and general construction work together with the practical suggestions and improvements therein, recommended by Dr. Park Benjamin, whose expert advice on these matters has been sought by the Commission. In fine, the report presents an excellent summary of the situation and reviews in a very complete manner the work of the year.

The Acheson Thermo-Electric Generators.

Mr. E. G Acheson, of Pittsburgh, Pa., whose thermo-electric generators have recently attracted so much attention, says with regard to their development: "Their

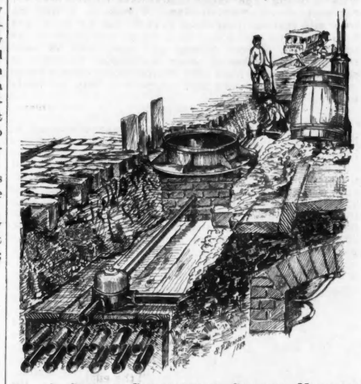


FIG 4.—SUBWAY CONSTRUCTION, SHOWING MANHOLES AND HANDHOLES.

economies are dependent upon so many conditions that my facilities have not enabled me to determine them. I have not been able to do much work on them since 1883. I was then in Paris and it was then and there that I produced them. I showed the gaseous generator, of which the illustration in THE ELECTRICAL WORLD was an exact drawing, to Count du Moncel, but his opinion was not such as to encourage me, and hence it has lain more or less dormant since. I tested the E. M. F. of this gaseous generator in the laboratory of Messrs. Elliott Bros., of London, and obtained 2½ volts, using about 250 degrees Fahr.

"The patent issued to me on Dec. 27 is the outcome of more recent work, although it is founded upon and worked up from the same theory which produced the above mentioned thermo-electric generator and which was found in 1883.

"While I believe that it is to the first publisher of a discovery that the honor belongs, and without any desire to detract from the honor due Messrs. Hinghausen and

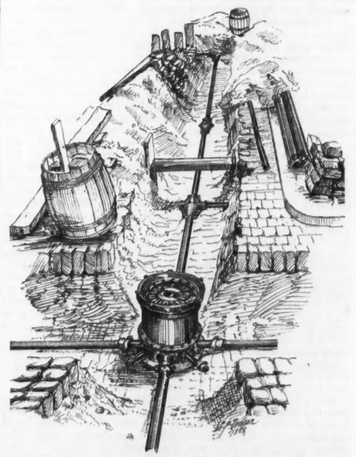


FIG. 5.—SUBWAY FOR EDISON INCANDESCENT SYSTEM.

Nerust, I wish, in justice to myself and as a means of establishing the links of the chain, to state that in the month of July, 1886, I made similar experiments to theirs and with like results. It may be that they did their work prior to this date, although the first notice I find of it is in the London *Electrician* of Feb. 18, 1887.

"The patent issued to me, entitled 'calelectric generator,' is the result of a further development of this subject, and while not in itself perfect, it is part of a system I am endeavoring to perfect, and has even now been much improved upon. It is yet early to make any statements in regard to the theory I have mentioned, and, indeed, do not know that it is necessary."